

Permafrost on the Kenai Lowlands

by Ed Berg



Kenai NWR biotech Toby Burke is standing in the black spruce forest near the hole where permafrost was detected at depth of 7 feet. Forest shade and a thick moss carpet insulate the cold permafrost. (Photo by author)

For years I have been telling people that we don't have permafrost on the Kenai, at least not in the lowlands. There is likely some permanently frozen ground in the mountains around and under the glaciers, but I have never seen permafrost in the broad muskeg peatlands that cover so much of the lowlands on the western side of the Kenai Peninsula. It's always dangerous in science to say "never," and this summer I had to eat my words. We do in fact have at least one small area of real permafrost in the large muskeg running northeast of Sterling.

This area of likely permafrost was identified on aerial photographs by Paul Glaser, a peatland expert at the University of Minnesota. Paul has studied permafrost in peatlands throughout the boreal forest and tundra regions of Canada and Alaska for many years. In 1997 he systematically went through the aerial photos of the Kenai and identified a spot 18 miles northeast of Sterling that showed a distinctive signature of round pockets of open areas within black spruce forest (see photo). These round pockets are scars where the permafrost has melted, and the trees have fallen down and disappeared into soggy peat. Over time the round pockets coalesce into clumps, and the muskeg forest is gradually converted into open fen with very shaky, water-logged ground.

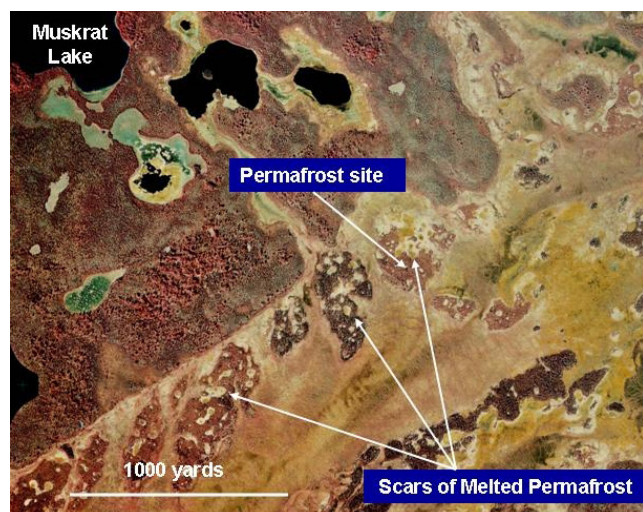
Mike Gracz, a wetland specialist from Homer, re-

cently signed on as a PhD graduate student with Paul at U-Minnesota to study peatlands on the Kenai. Paul came up this summer to check out possible field sites with Mike, so Mike lined up helicopter to fly us out for a closer look at the possible scars that Paul had picked out on the photos.

The round pocket areas proved to be very shaky walking and we constantly had the feeling we might punch through the soggy surface into water below. We used a 19-foot steel rod to probe the peat and never hit bottom. Frequently we stumbled over buried black spruce trunks that had fallen into the wet peat and were overtopped by fast-growing Sphagnum moss. Paul said that this extreme soggy is typical of melted permafrost in a peatland. In normal non-permafrost peatland typical of the Kenai lowland, the peat is fairly firm even though the water table is near or at the ground surface. In recent decades black spruce forest has grown up around the perimeters of many Kenai peatlands, often growing on top of peat that is 5 to 20 feet thick and quite solid.

The high point of our day arrived when Mike and Kenai Refuge biotech Toby Burke dug a hole back in the woods and hit unmelted permafrost at a depth of seven feet. There the closed-canopy black spruce forest and a thick moss layer provide insulation that has retarded the permafrost melting. Even so, the five feet of soil above the permafrost was quite loose and wet, which indicated that the permafrost has been melting, regardless of its insulation. We conjectured that within the next few decades the nearby melted open pockets will expand and swallow up all of this forest.

There have been occasional earlier reports of permafrost on the Kenai. Pioneering Alaska geologist David Hopkins and colleagues published a USGS report in 1955 that described permafrost under black spruce islands on the east edge of the Kenai lowlands, 20 miles east of Kenai. Their report shows a 1946 US Army Air Force oblique photo of the general area that we visited, but interestingly the permafrost scars are much less developed than they are in the 1988 photo shown here.



The round white patches are permafrost collapse scars. The permafrost site that we visited is 18 miles north-east of Sterling in the large muskeg between Sterling and Mystery Creek. (Aerial photo is 1988 false color infrared, provided by the Kenai NWR.)

Permafrost is of course a fact of daily life in interior Alaska. On the North Slope permafrost from the last ice age extends to depths of 2200 feet in the zone of continuous permafrost. South of the Brooks Range the zone of discontinuous permafrost extends as far south as Anchorage, with permafrost typically restricted to peatlands and areas of poorly drained soils. A 1977 study reported that 2-5% of the Anchorage area is underlain by permafrost, generally at depths of 15 to 35 feet, with the largest known patch being 30 acres in size.

Melting permafrost is a major issue in the Interior. Many roads and buildings are built on permafrost that is starting to melt. Roads buckle, and buildings sag as once-solid soil becomes unstable when the ice component melts. Thermokarst ponds develop in lowland forests, and trees tip into ponds, creating “drunken forests.” The whole surface of the landscape becomes quite wet. I remember flying over the Tanana Valley to Fairbanks one afternoon with the sun setting in the west; the sun reflected off of hundreds of thermokarst ponds and made the entire valley look like a shimmering flooded forest.

On the Kenai we have the opposite situation. Not having permafrost, our landscape is drying, except for this exceptional situation northeast of Sterling. Our wetlands are becoming increasingly shrubby and invaded by black spruce, and we don’t have thermokarst ponds and drunken forests. Water levels in closed-

basin lakes have declined, especially since the 1990s, and former ponds have turned into grassy pans.

It is interesting to speculate on the history of this localized spot of Kenai permafrost. It is highly unlikely that this permafrost is a relic from the last ice age, because most peat deposits on the Kenai have formed within the last 14,000 years, after the glacial ice had disappeared. Furthermore, it is unlikely that permafrost would have survived the warm Holocene Thermal Maximum (or Hypsithermal) period 9-11,000 years ago when summer temperatures were probably several degrees F higher. There have been several periods of minor glacial advance in the last 2500 years, suggesting colder summers, but the best candidate is the Little Ice Age which spanned roughly the 1300s through the 1850s. According to our estimates of summer degree-days based on tree-ring reconstructions for the Kenai Mountains, the coldest parts of the Little Ice Age were in the 1670s, early 1700s, and the 1810s-1820s.



Ground view of a permafrost collapse scar. The waterlogged ground was extremely shaky to walk on. Probing with a steel rod indicated that the soggy peat was more than 19 feet deep. (Photo by author)

To the best of my knowledge, there is presently no direct way of aging permafrost, i.e., of telling when permafrost became frozen. One can use radiocarbon dating to date the organic matter in permafrost, such as peat, but this matter could have been sitting on the landscape for thousands of years before it froze.

It should be possible to use tree-ring dating to determine the death dates of trees in the melted scar areas. Knowing death dates of the trees would tell us when the permafrost melted sufficiently to drown the trees. Most of the trees I examined were pretty well decayed, but the trunks underwater should be much

better preserved and have wood solid enough to date with tree rings, just as we date old log cabins and burn poles from old forest fires. Dendrochronologists (tree-ring specialists) in many places in Europe and North America have used well-preserved wood in lakes and rivers to date old piers, archeological sites flooded by impoundments, and sunken ships.

Melting permafrost is yet another talisman of our warming climate on the Kenai. It's not a big effect compared to the spruce bark beetle outbreak, drying

wetlands, retreating glaciers, and rising treeline, but it does mark a rising tide.

If you have access to GoogleEarth on a computer, you can view the permafrost site at 60.70070°N, 150.34563°W.

Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. Previous Refuge Previous Refuge Notebook columns can be viewed on the Web at <http://www.fws.gov/refuge/kenai/>.